Crash Test Evaluation of Rear Seat Occupant Protection

Suzanne Tylko, Chief of Crashworthiness Research
Transport Canada

National Transportation Safety Board

Washington DC, April 26, 2016

Transport Canada Disclaimer

Neither Transport Canada, nor its employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy or completeness of any information contained in this presentation, or process described herein, and assumes no responsibility for anyone's use of the information. Transport Canada is not responsible for errors or omissions in this presentation and makes no representations as to the accuracy or completeness of the information. Transport Canada does not endorse products or companies. Reference in this presentation to any specific commercial products, process, or service by trade name, trademark, manufacturer, or otherwise, does not constitute or imply its endorsement, recommendation, or favoring by Transport Canada and shall not be used for advertising or service endorsement purposes. Trade or company names appear in this presentation only because they are essential to the objectives of the presentation.

Objectives

1. Monitor existing regulations and provide the necessary scientific evidence for the development of new or amended regulations;
2. Provide scientific evidence to advance crash test dummy technology.

Programs

I. Protection of adult/ child occupants

1) Frontal Crash

- Interactions with the vehicle interior
- Influence of restraint system

2) Side Impact Crash

- Interactions with the vehicle interior
- Influence of restraint system
- Interactions with non-struck side occupants

II. ATD development

Information sharing

1. Shared with the NHTSA
2. Industry
3. Safety Organizations

Outline

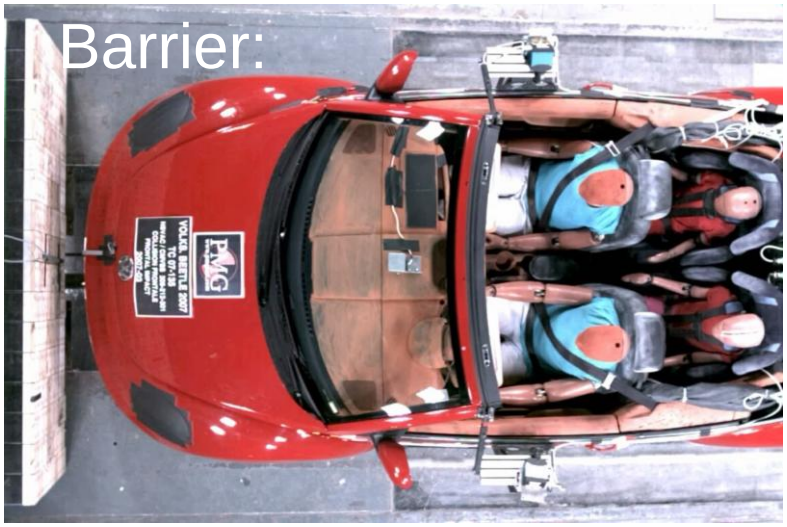
1) Full frontal rigid barrier
    - Comparison of front and rear seat responses
    - Head & neck response in rear seats
    - Child restraint securement
2) Moving-car to moving-car 40% frontal offset crash tests
    - struck side curtain interaction
    - Non-struck side containment

Methods:

High-speed videos are recorded at 1000 frames/second

- lateral views of the front seat occupants;
- lateral and a frontal view of the rear seat occupants.

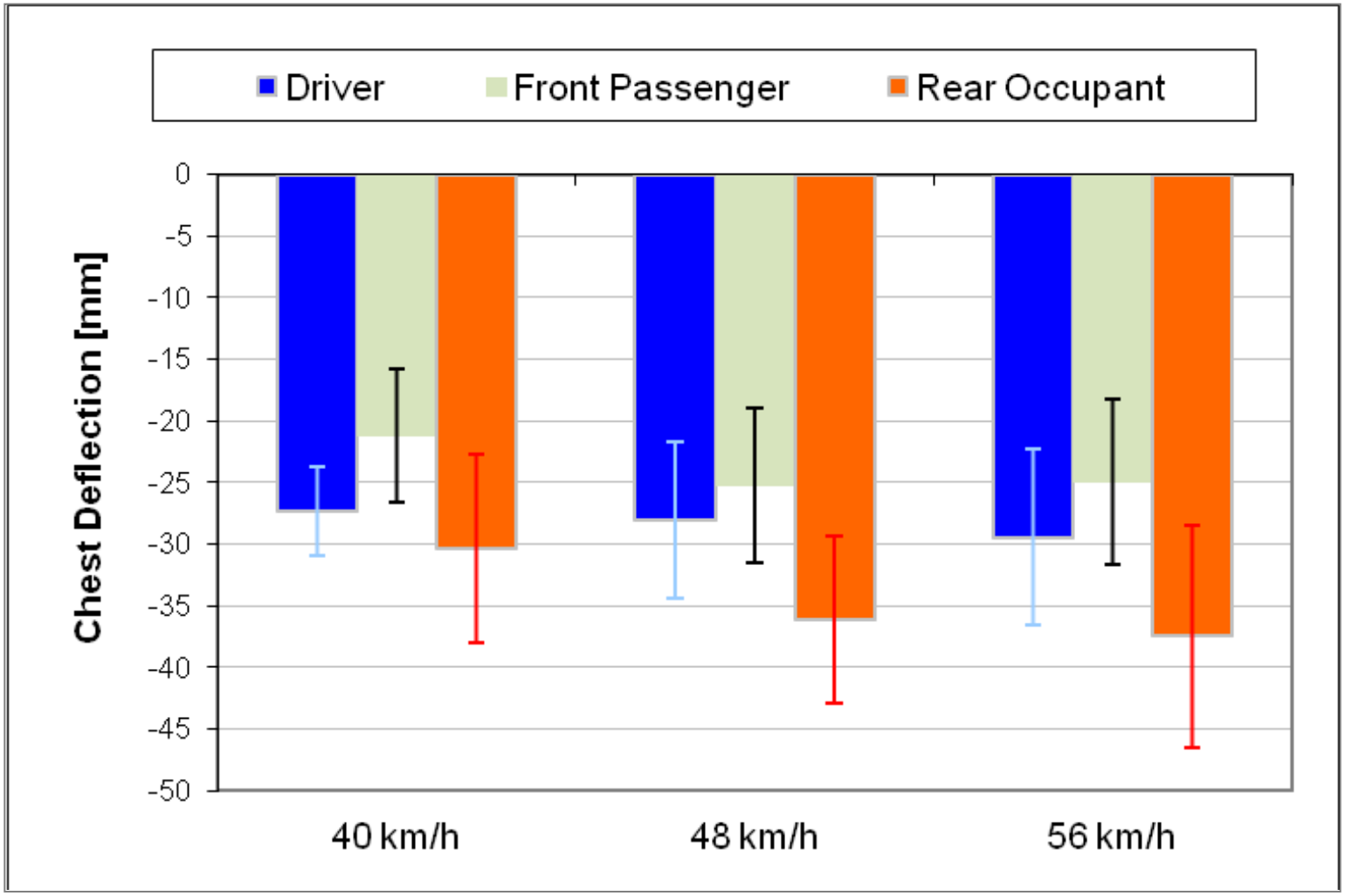
Impact speeds: 48 km/h 56 km/h



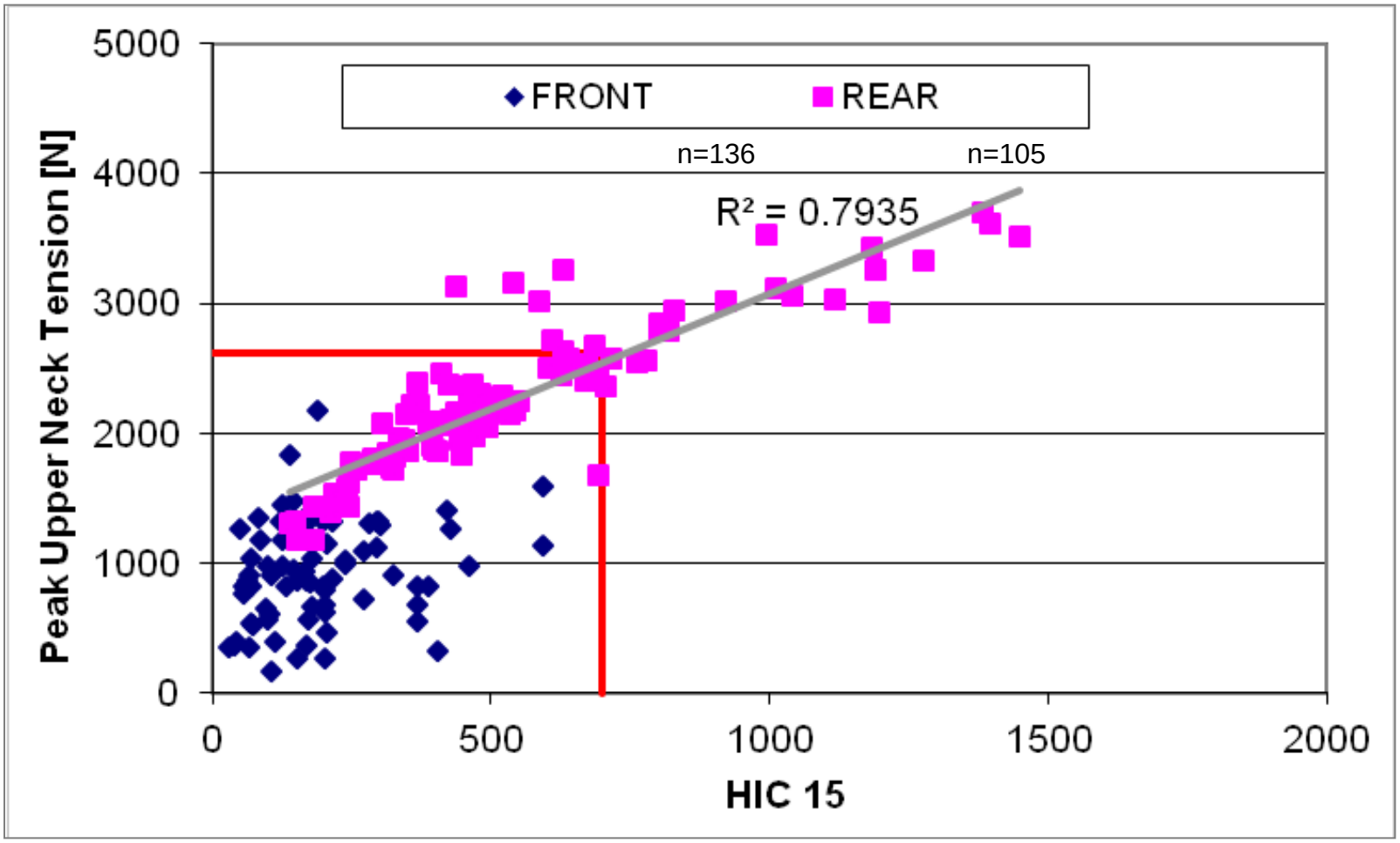
Paired comparisons

Oblique responses

CHEST DEFLECTION RESPONSE OF THE HIII 5th



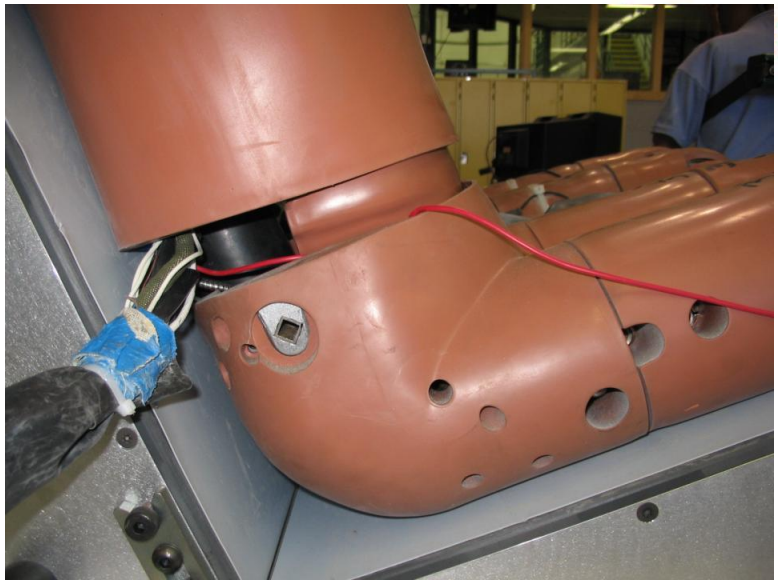
Head & NECK RESPONSE OF THE HIII 5th

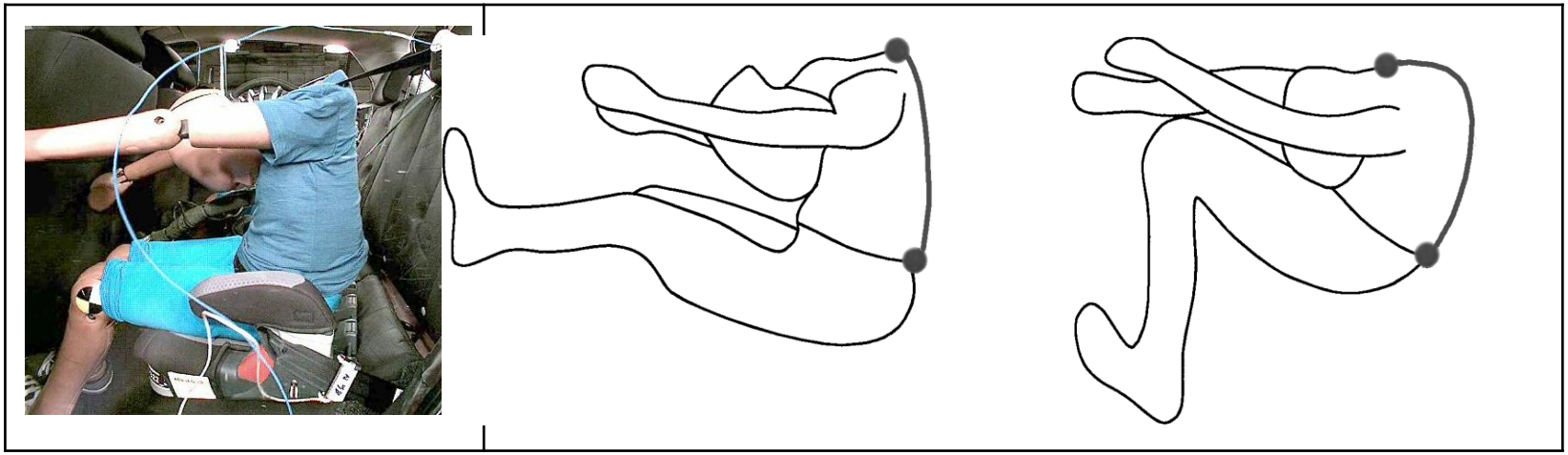


Motion in the front seat is more controlled, ATD remains upright;

Motion of rear seat ATDs varies as a function of seat characteristics & belt anchorage geometry

Hybrid III dummies have a rigid spine box and a seated pelvis





Sherwood, C, Shaw, C, Van Rooij, L, Kent, R, Crandall, J, Orzechowski, K, Eichelberger M, Kallieris D, Prediction of Cervical Spine Injury Risk for the 6-Year-Old Child in Frontal Crashes, *Traffic Injury Prevention*, 4:206–213, 2003.

Observations

1. Seat location in the vehicle, including proximity to the airbags and knee bolsters, in front row seats was found to influence the kinematic responses of the Hybrid III 5th percentile ATD.
2. ATDs restrained in rear seat locations exhibited much greater forward displacements relative to the seat cushion and lap and shoulder belt.
3. Chest deflection is greater and is dependant on impact velocity.
4. The rigid spine and moulded seated pelvis of the ATD interfereswith flexion and prevent head contact with the interior.

CRS Securement

Top tether + LATCH + belt

Top tether + belt

In 56 km/h rigid barrier tests excursion for combined attachments was less.

Importance of Top Tethers

Importance of Top Tethers

Multiple Occupancy

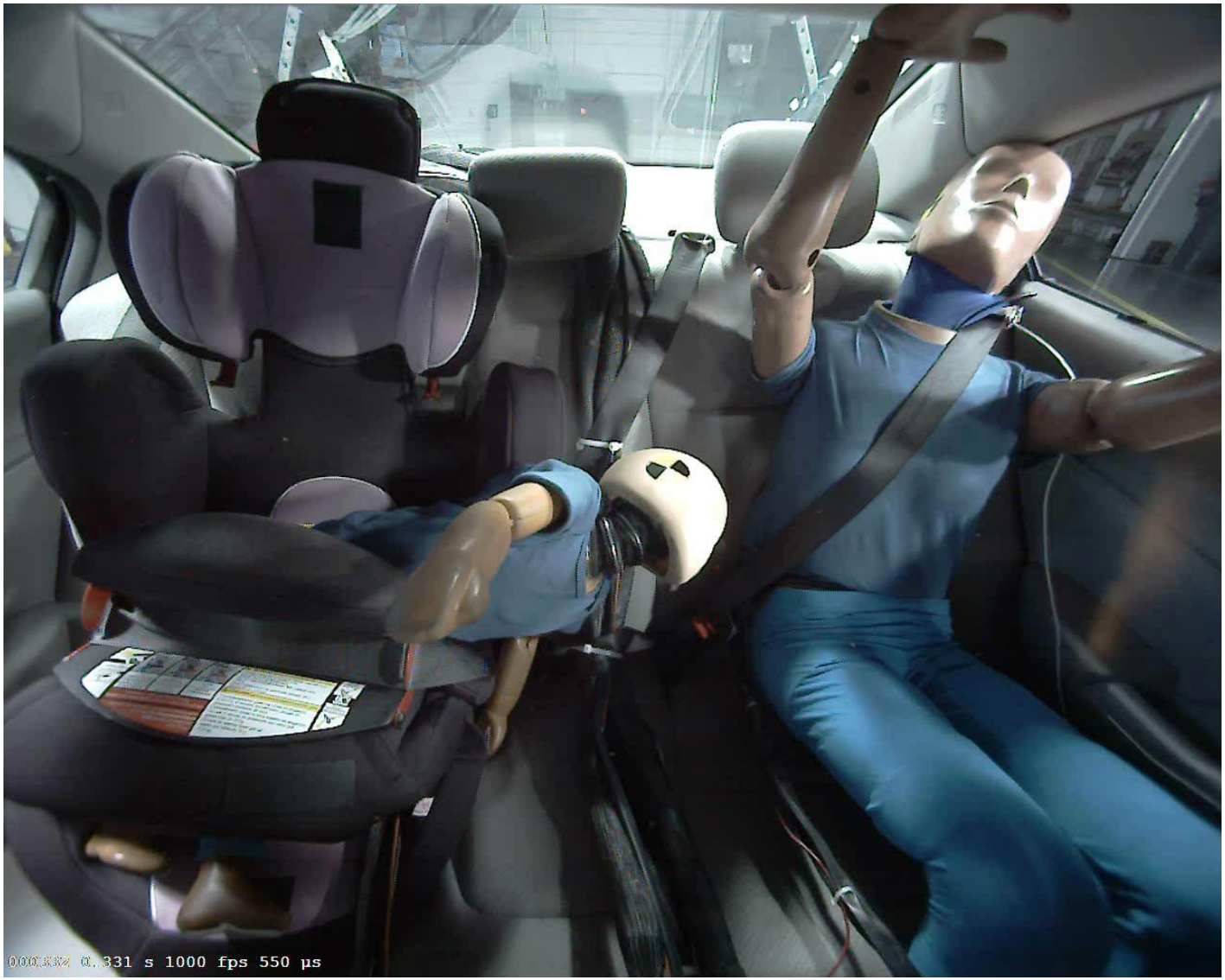
Observations

1. Excursion for belt + top tether installation is greater than for belt + LATCH installations.
2. Head/ face contact with front seatback can be problematic when trim is present.
3. Top tether attachment should play a critical role in retention of the CRS.
4. Beyond fitment, multiple occupancy presents important safety challenges.

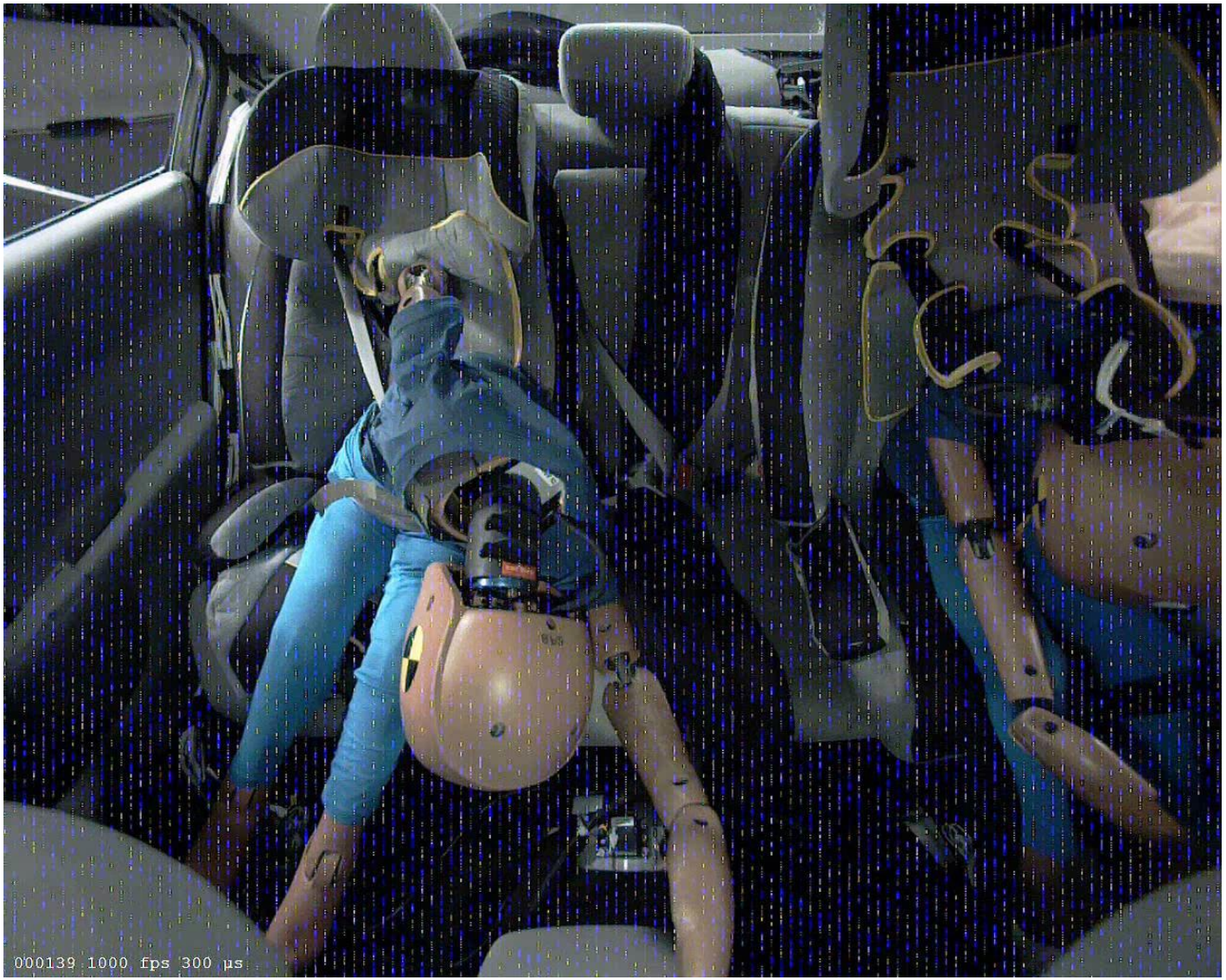
Frontal Offset Curtain Interaction

Frontal Offset Curtain Interaction

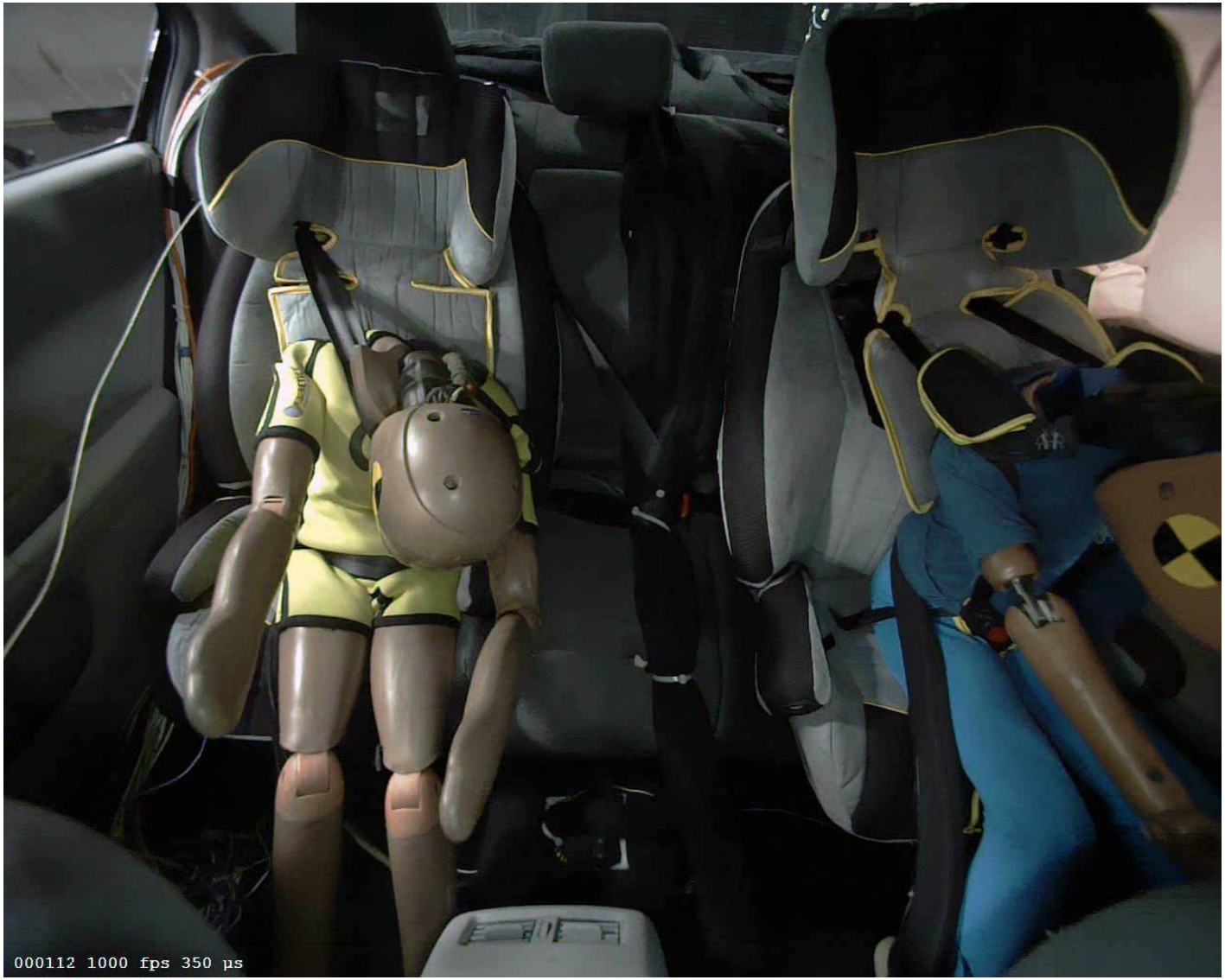
Frontal Offset Ejection



Frontal Offset Roll-Out of Hybrid III



Frontal Offset Neck Interaction of Q6



Conclusion

The environment in the rear seat is completely different from the front seat.

Improvements will require:

1. Increased awareness
2. Advances in ATD designs
3. Development of appropriate criteria

Acknowledgements

PMG Technologies for sharing my passion and providing expert test services

NTSB for funding my participation at this important meeting.